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ANY TIME FOOD PROCESSING MACHINE

N DINESH KUMAR[1], CHINTAM V B ADITYA KUMAR[2], M JAYAPRAKASH[3] & V NAVEEN REDDY[4]

[1]Head & Associate Professor, Electronics & Instrumentation Engineering, Vignan Institute of Technology & Science, Deshmukhi, Andhra Pradesh, India

[2]Assistant Professor, Electronics & Instrumentation Engineering, Vignan Institute of Technology & Science, Deshmukhi, Andhra Pradesh, India

[3,4]UG Student, Electronics & Instrumentation Engineering, Vignan Institute of Technology & Science, Deshmukhi, Andhra Pradesh, India

ABSTRACT

The production of high quality and hygienic products is given first priority in the food processing industry. This paper was taken up with a view to improve the hygienic constraints of the present system of food process. The design is implemented using the concepts of Low cost Automation (LCA). LCA greatly reduces the need for human sensory and mental requirements. The aim of this project is automating the processing food in the industry that still using manual system. This project describes a design and Implementation of Automation Controller using Electro pneumatic and PLC for food processing. The proposed model system is designed based of the usage of pneumatic, electro pneumatic and Programmable Logic Controller (PLC). Automation machine can gives more advantages to the industry such as it can improve quality and accuracy of the product, increase productivity and also tremendous amounts of power and energy which humans do not possess will be decrease by using automatic machines like electro-pneumatic and PLC. This system can be applied in industries that are developed to automatic system**.**

KEYWORDS: Corn & Juice Extraction, Ladder Network, LCA, PLC, Step, **7**

INTRODUCTION

In the recent past, Automation techniques have become one of the effective strategies in the modern manufacturing process. Most of the manual operations involved in the production are being automated to get multifarious benefits. The existing systems are to be automated to get preciseness and accuracy in their operations. A better controller always enhances the quality in its operations & throughput. When a particular item is selected from the menu, it has to check the coin count and then it has follow the correct timing and sequence in extracting them. Monitoring the level while extracting the juice and corn is of very important. nd coin count required at correct timing and sequence has to be maintained and any error in the above things can make the difference in the quality. The PLC strategy implementation for a control task closely follows the development of an algorithm.

DESIGN OBJECTIVE

The main objective of this paper is to increase the throughput in hygienic conditions with minimum labour. Juice & corn extraction can be altered according to the requirements at any time.

Present Conventional Method

The present method of juice & corn extraction is manual & semi automatic and time taking process with least hygienic values and low precession and a costly affair.

Proposed Method

The whole unit is divided into two sub-units juice extraction unit and corn extraction unit. After verifying the conditions for the money input and the menu selection the working of the sub-unit starts.

Juice Extraction Unit

If the fruits are present in container then the actuator retracts allowing the fruits in to the crusher section. Then actuator moves in the forward direction and applying pressure on the fruits and motor runs which results in juice extraction from one side and waste from another side.

Corn Extraction Unit

Here induction coils are used to maintain the corn in boiled state, the sensor checks the temperature and if it drops then coils are ON if item is more than preset range it OFF the coils which results in power saving. When another sensor senses a signal indicating the presence of the corn in it then the actuator retracts letting the corn to fill the mesh compartment, after it is filled it gets off. The PLC strategy implementations for a control task closely follow the development of an algorithm and produce the solution in a finite number of steps. Figure-1 presents the block diagram of the proposed method.

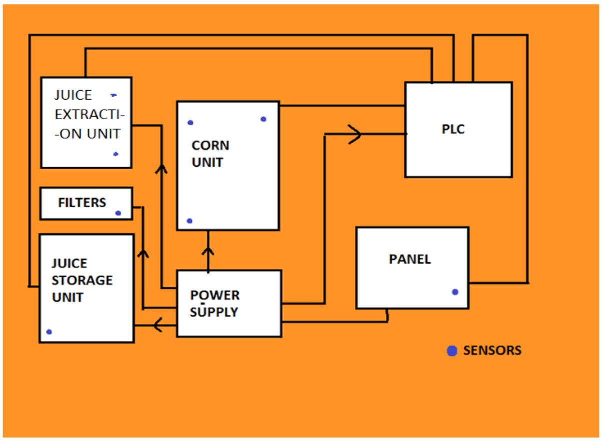


Figure 1: Block Diagram

HARDWARE AND SOFTWARE

After deciding the efficient sequence of operations for suggested method, the appropriate actuators and sensors are chosen. All the sensors, actuators and other apparatus required for the connections have been taken for the simulation of input/output modules of PLC. By giving the power supply to the PLC, the program is transferred from computer to PLC after final verification by using **step-7 software**.

Hardware

The hardware used in the process are broadly classified into following categories: DC Motors, Pneumatic Cylinders/Actuators, Sensors, induction coils, Relays, PLC Trainer

Design Specifications

Front Panel: The front panel of the design is shown in the figure 2. It contains different switches which an user can select. The panel also shows power options like solar or general power that can be utilized by the machine.

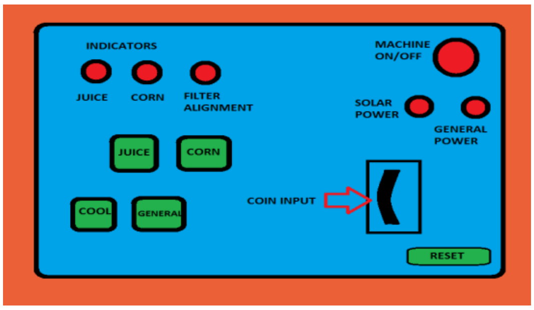


Figure 2: Interface Panel Design

Corn Unit Design: The internal structure of the corn unit is shown in the figure 3.

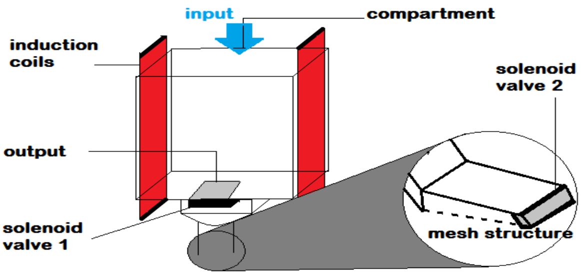


Figure 3: Corn Unit

Juice Crushing Unit Design: The process of the juice crushing unit is shown in the figure 4.

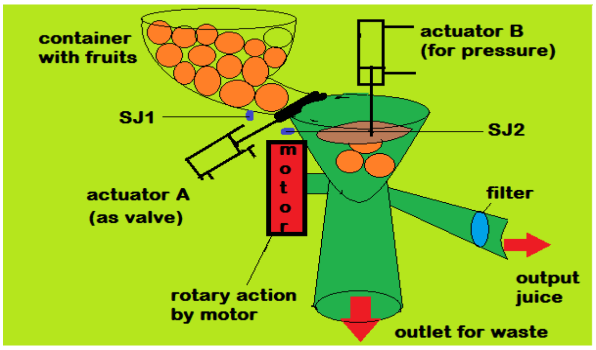


Figure 4: Juice Crushing Unit

PLC INPUT & OUTPUT SPECIFICATIONS

Inputs & outputs used in PLC for the proposed design are listed in table 1 & 2.

Table 1: I/O Specifications for Juice Module

Inputs	
START BUTTON(S/B)	I 124.0
SCOIN	I124.1
RESET	I124.2
BUTTON 1	I124.3
BUTTON 2	I 124.4
BUTTON 11	I124.5
BUTTON 12	I124.6
SJ1	I124.7
SJ2	I125.0
Outputs	
A1	Q124.0
A2	Q124.4

Table 1: Contd.,

M1	Q124.5
A3	Q124.6
SC	Q124.7

Table 2: I/O Specifications for Corn Module

Inputs	
START BUTTON(S/B)	I 124.0
SCOIN	I124.1
RESET	I124.2
BUTTON 1	I124.3
BUTTON 2	I 124.4
BUTTON 11	I124.5
BUTTON 12	I124.6
SCORN	I124.7
SIND	I125.0
Outputs	
C,D	Q124.0
C,D	Q124.4
INDUCTION COILS	Q124.5

Algorithm & Flow Chart

- Start the process (Switch ON the Start button).
- Check the initial conditions
  - All the motors OFF
  - Actuators A, C, D in (forward position), actuator B in retract position.
  - Induction coils on.
  - Indicators working(LEDs)
- Insert the coins through the slot provided in panel.
- If the coins are inserted then activate the buttons B1, B2, choose any one.
- If B1 is chosen activate buttons cool or General (B11, B12).
- If B11 is chosen then check weather fruits are present in the container are not (Sj1) then if yes on the actuator A if no return to before step.
- Move 2 fruits (SJ2 senses) in to the crusher unit then Off Actuator A, ON Actuator B, Motor M simultaneously.
- If Sensor Sj3(present in the storage unit) senses a signal then off B,M and on the submergible pump and output is collected at collection point .
- If B12 is chosen repeat the steps 6, 7, 8 and ON the super cooler present over the output pipe.
- If B2 (corn) is chosen sense weather corn is present or not using Scorn sensor if yes on the actuator C.
- With required time delay of the manufacturer's choice OFF the actuator C and On the actuator D and output is collected in the Collection point, after the collection of the output D is resetted.
- Auto reset the whole process

Flow chart showing all the steps above is shown in the figure 5.

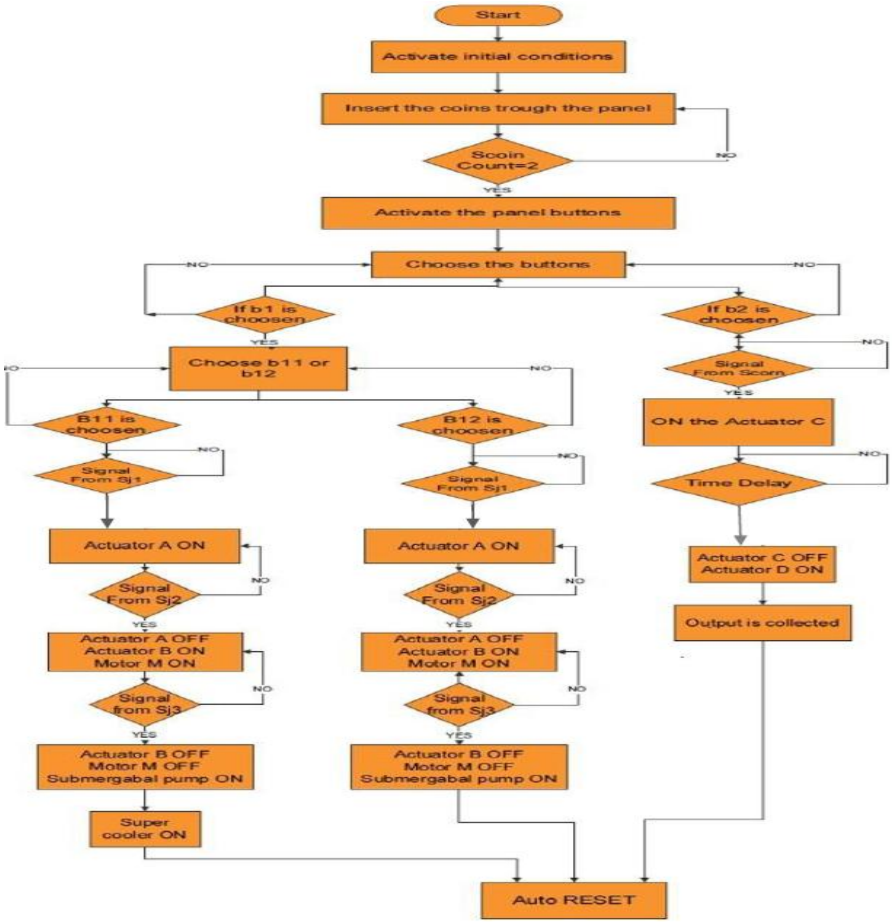


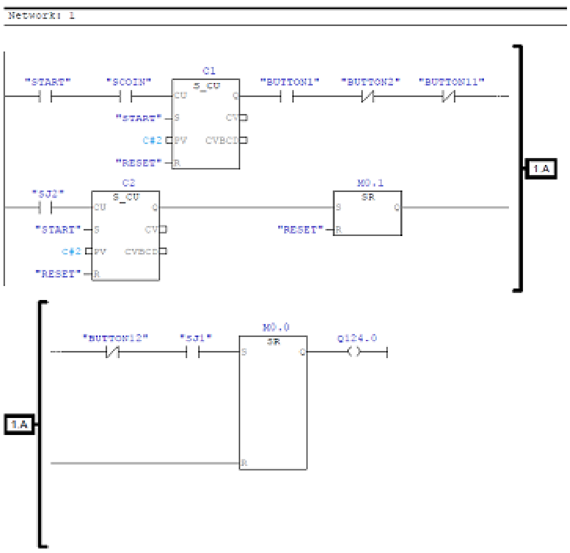
Figure 5: Flow Chart

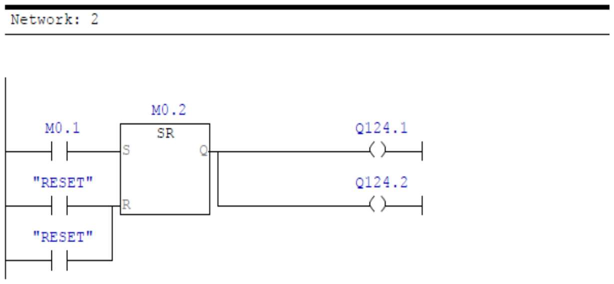
Software

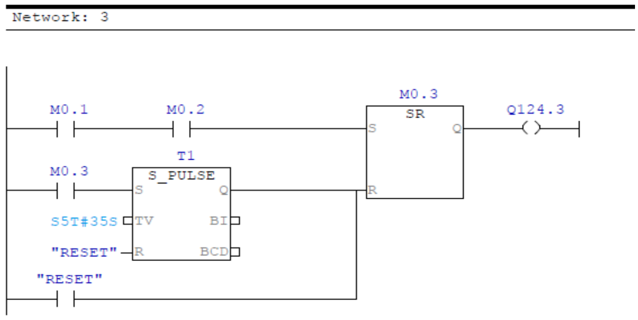
In order to program the Siemens PLC-control series S7-300 and S7-400 efficiently and comfortably the software **S7 (Step 7) for Windows** can be used. The complete S7 instruction set is implemented in Ladder Diagram (LAD).

SIMULATION MODEL

SIMULATION MODEL FOR CORN

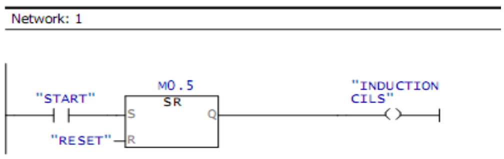


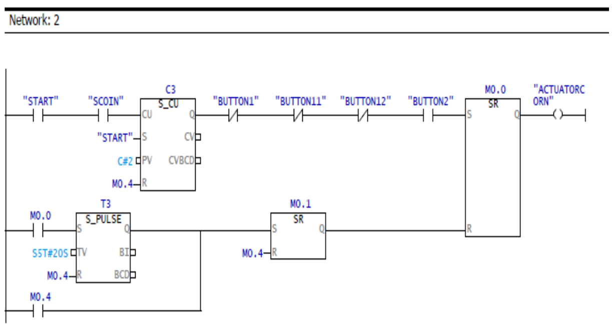


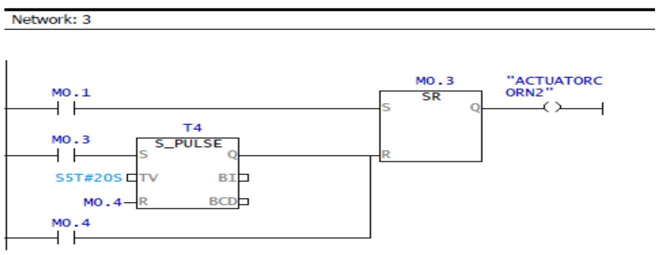


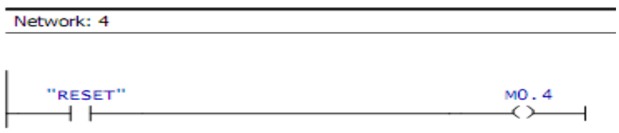
SIMULATION MODEL FOR JUICE

The results are shown below using ladder diagrams.









In the laboratory setup, it has been observed whether the PLC is transferring the correct signals to actuate the cylinders in desired sequential order.

COST ANALYSIS

This analysis gives the estimation of total cost required for the whole unit setup. The costs of various elements used in our project were taken from FESTO SYSTEMS Pvt Ltd., a manufacturing and distributing company. While arriving at payback period, case analysis of small scale restaurant is considered for profit and expenditure financial figures.

Estimated Cost

The costs of various elements used in our project were taken into consideration before arriving at an estimated cost of the unit. Table 3 gives an estimated Cost (excluding PLC) for the implementation of the complete setup.

Table 3: Cost Estimation

Component Name	No. of Pieces	Price Per Piece	Total Price
Double acting cylinder	4	1900	7600
3/2 single solenoid valve	4	1200	4800
Sensors	7	450	3150
PLC	1	45000	45000
Air compressor	1	10000	10000
Air filter regulator	1	1400	1400
Connecting pipes, wires	Misc	2000	2000
Fabrication	Misc	5000	5000
Driver motor	1	3000	3000
Induction coils	2	1500	3000
On/off valves	4	500	2000
Submergible pump	1	500	500
push buttons, LEDS	1	500	500
Solar Panel	1	10000	10000
TOTAL			**Rs. 95,950.00**

Estimated Recovery Period

Total Investment (Without Taxes) = Rs.95,950 + 1,00,000 (PLC Cost)

Amount saved on Labor per Month = Rs 1,000*30 = Rs. 30, 000

Total Expenditure per Month on Electrical charges and Maintenance = Rs.30,000

Total profit per month assuming a business of Rs. 2,000 per day = Rs.60,000 (in manual operated process)

Total profit per month assuming same amount of business of Rs. 2,000 per day (in automated operated process)

= Amount saved on Labor per Month

= 30,000

= Rs.30,000 + Total profit per month assuming a business of Rs. 2,000 per day (in manual operated process)

= Rs. 90,000

Depreciation factor (D.F) = 0.15

Pay Back Period = Total Investment **/** (Net Profit X **(**1-D.F**)**)

= 2.56 = 3 **Months** (approx)

CONCLUSIONS

The experimental results shown and tested are as per the basic requirements of any food industry. A sequence for the given operation has been performed by using pneumatic drives as per the developed circuit. The main consideration is recovery of invested capital. The application of LCA, particularly in small scale industries with the usage of simple devices like pneumatic and hydraulic actuators with electrical control to the existing conventional methods will make the automation at low cost to yield higher productivity for stability and growth of economy of the nation.

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REFERENCES

1. N Dinesh Kumar, Chintam V B Aditya Kumar, E Swetha, P Anirudh Srinivas, “Automated Universal Hygienic Food Processing Machine”, International Journal of Electronics, Communication & Instrumentation Engineering Research and Development (IJECIERD), Vol. 4, Issue 1, Feb-2014, 19-26.
2. John W Webb, Ronald A Reis, 2002, PLC Principles and Applications, Prentice Hall’s, “Chap 5, 9 & 28”
3. Henry Ward Beecher, 2nd Edition “Introduction to PLC Programming and Implementation from Relay logic to PLC Logic” Industrial text & Video, Chap 9 & 13
4. Hugh Jack, 2005, “Automating Manufacturing Systems with PLCs”, Chap 3, 4, 5, 9 & 24.
5. N Dinesh Kumar, Chintam V B Aditya Kumar and B Alekya, “Sorting of material based on Height and Width using Automation” **Journal of Instrument Society of India, IISC Bangalore., Vol. 41, no.2,** Sep. 2011.
6. Nasita Binti Ibrahim, Apr, 2006, “Implementation of automation controller using Electropneumatic & PLC for food processing”, B.Tech Thesis KUKT, Malaysia.